

## CCD-scale Far-IR Detector Arrays Using Code Domain Multiplexing

Completed Technology Project (2013 - 2014)



## Project Introduction

Large-format far-infrared arrays using, for example, superconducting transition edge sensor (TES) bolometers, have only achieved 1,000-pixel formats. Lagging behind other wavelengths due to lesser commercial/industrial technology investments, the potential for revolutionary improvement to megapixel formats has been the long term goal for far-infrared detector research for the past decade, when single-pixel detectors achieved background-limited performance for most applications. The greatest challenge for producing very large (greater than 10 kpix) format far-IR detectors is in readout multiplexing. Several approaches (for TES detectors, time domain, audio frequency domain, and microwave frequency domain SQUID multiplexing) have been demonstrated in laboratory and a few ground-based experiments. However, none of these techniques has yet fielded a system with better than 40:1 multiplexing ratios. For very large arrays, this is a limiting constraint. Recently-developed Code Domain multiplexing (CDM) promises 100:1 multiplexing on a two-year timescale, with 10,000:1 multiplexing ratios over longer timescales. We will demonstrate the CDM technology necessary to scale up to produce spaceworthy, far-infrared detector arrays scalable to 40,000 pixels.

For this program, we are partnering with Stanford University, who will provide CDM multiplexers. We will assemble the multiplexers into a scalable detector test configuration to demonstrate operation and evaluate the achievable multiplex factors. The final result of this work will be to build and demonstrate a complete end-to-end CDM-based SQUID readout of a far-IR bolometer array. Stanford will develop and provide the multiplexers; Goddard will purchase and assemble the electronics and software necessary to use the multiplexers; Goddard will fabricate and integrate a small TES bolometer array in a package customized for this purpose.

## Anticipated Benefits

Explorer missions, Stratospheric Observatory for Infrared Astronomy (SOFIA) instruments, and far-future missions such as Single Aperture Far-Infrared Observatory (SAFIR).

TES bolometers on the South Pole Telescope



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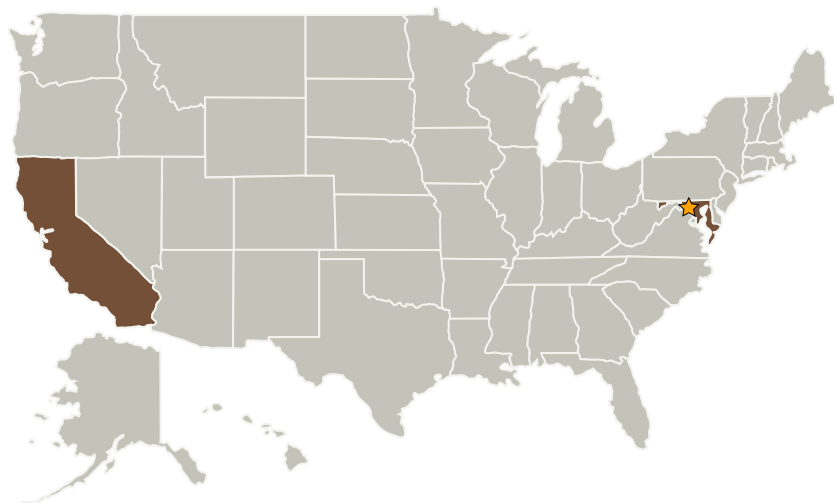
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## Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Goddard Space Flight Center(GSFC)	Lead Organization	NASA Center	Greenbelt, Maryland
National Institute of Standards and Technology(NIST)	Supporting Organization	US Government	Boulder, Colorado

Primary U.S. Work Locations	
California	Maryland

### Project Website:

<http://sciences.gsfc.nasa.gov/sed/>

## Organizational Responsibility

### Responsible Mission Directorate:

Mission Support Directorate (MSD)

### Lead Center / Facility:

Goddard Space Flight Center (GSFC)

### Responsible Program:

Center Independent Research &amp; Development: GSFC IRAD

## Project Management

### Program Manager:

Peter M Hughes

### Project Manager:

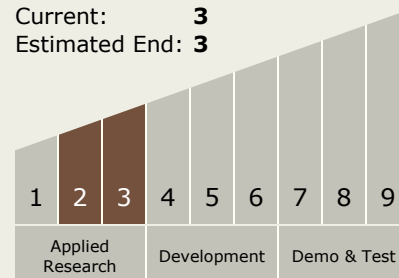
Terence A Doiron

### Principal Investigator:

Christine A Jhabvala

## Technology Maturity (TRL)

Start: 2  
Current: 3  
Estimated End: 3



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## Technology Areas

### Primary:

- TX08 Sensors and Instruments
  - └ TX08.1 Remote Sensing Instruments/Sensors
    - └ TX08.1.1 Detectors and Focal Planes